

Energy Solutions For Poultry Producers



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Check Out Auburn University's Poultry Housing Program On The Web

www.poultryhouse.com

**Newsletters, Field Reports, Technical
Reports, Books, Videos, etc.**



Discussion Points

Engineering & Economic Aspects Of:

- I. Sealing And Tightening Houses
- II. Solid Walls And Insulation
- III. Ventilation Management
- IV. Propane Pricing Options
- V. Alternative Energy Systems



About Today's Information

← Using Information From One Person Without Due Credit is Called Plagiarism.

← Using Information From A Lot Of People Without Due Credit Is Called Research.

← Today We're Doing Research!

Credits To Mike Czarick, Dave Bransby, Keith Cummings,
Duran Fasina, & Several Growers/Companies

I. Sealing & Tightening Houses





What Is A Tight Poultry House?

- ← House Should Pull A .10-.15 Static Pressure With 1 – 48” Fan On & All Doors/Inlets Shut
- ← New Houses Pull Around .22 - .33
- ← Old Houses Can Get To .15 - .25
- ← Foam, Tape, & Caulk Are Our Best Friends
- ← Smoke Test For Leaks
- ← Insulation Is Worthless If The Door Is Open!

Main Sources Of Air Leaks

- ← Top & Bottom of Curtains
- ← Tunnel Inlets
- ← Around End Doors/Man Doors, Fans
- ← Exterior Wood Joints, Pipe & Tube Holes
- ← Backflow Through Closed Shutters
- ← **1/4" Leak Down Both Sides Equals 20 Square Feet - One Man Door (6'8" X 3')!





House Tightness Study

- ← Two 40' x 400' Open Ceiling Houses, 25+ Yrs Old
- ← With One 48" Fan On & Inlets Closed- Obtained Static Pressure of 0.03
- ← Applied Spray Foam To All Sidewall, End Wall, and Ridge Cracks.
- ← Weatherstripped Doors, Sealed Unused Openings.
- ← Installed Curtain Flaps & Boots.
- ← After Re-working, Static Pressure Was 0.16.
- ← Heating Costs Now Reduced By 30%.
- ← Better Settlements Every Flock.
- ← In Summer, Fan End Is 3-4 Degrees Cooler.

Sealing/Tightening Benefits

- ← Significant Energy Savings
- ← More Uniform Bird Environment
- ← Improved Temperature Uniformity
- ← Easier to Ventilate Properly



****29 Year Old Retrofit – SP=0.23**

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Where to Spend Your Money

- ← Seal Tunnel Inlet Curtains
- ← Seal Around Unused Doors and Fans
- ← Seal Any Structural Air Leaks You Find
- ← Install Curtain Flaps and Boots
- ← Nail and Seal Curtain Bottom
- ← Insulate Wherever Possible
- ← Adjust and Properly Operate Vent Boxes
- ← Install Stirring Fans
- ← Consider Solid Walls Or At Least Smaller Curtain Opening

Cover & Seal Unused Fans



II. Solid Sidewalls And Insulation



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Poultry Housing is Changing

- ← Steel, Lumber, Labor, & Energy Costs Are At Record Highs**
- ← More Strict Bird Requirements**
- ← Mature, Highly Competitive Industry**
- ← New Tools, Equipment, & Management Must Be Incorporated Into Housing**
- ← Trend World Wide To Wider Houses With Solid, Well Insulated Walls**
- ← Lower Cost Per Ft² With Wide**
- ← Lower Energy Costs With Solid + Insulation**

Solid Sidewalls - Not Just For Up North Anymore



Worldwide Trends – Solid Walls, Wider Houses



New Zealand



Russia



Australia



Solid Sidewall Benefits

- ← Significant Energy Savings**
- ← Better Bird Environment**
- ← Better Temperature Uniformity**
- ← Tighter Solid House Easier to Ventilate**
- ← More Ventilation Efficiency**
- ← Eliminates Curtain Drops**
- ← Eliminates Curtain Replacement**



Possible Problems

- ← Can't Air Out The House As Well
- ← More Difficult To De-Cake And Run Housekeeper
- ← Increased Cost - Life of House?
- ← The Importance Of Continuous Electrical Supply Must Be Evaluated
- ← No Failsafe Other Than Generator



Insulation of Selected Materials

← Curtain - R-1

← Wood - Average R-1/in.

← Polystyrene Beadboard - R-3/in.

← Blown Cellulose, Fiberglass - R-3.2/in.

← Fiberglass Batts/Blankets - R-3.2/in.

← Extruded Plain Polystyrene - R-5/in.

← Aged, Unfaced Polyurethane Foam - R-6/in.

← Closed Cell Foam, Sprayed - R-7/in.



Recommended Insulation

- ← Sidewalls & Endwalls R-8 To R-11
- ← Big Doors & Man Doors R-5 To R-8
- ← Ceiling R-19 Min. , Blown or Mixed w/ Batts
- ← Over time – Moisture, Settling, Shifting, & Compression Decreases Effective R Value.
- ← R-19 Blown Needs To Be 5.5” Minimum
- ← Builder Should Provide You With Total Number Of Bags/Bundles Used Per House.
- ← After Crew Is Done, Check The Thickness.

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Costs To Consider

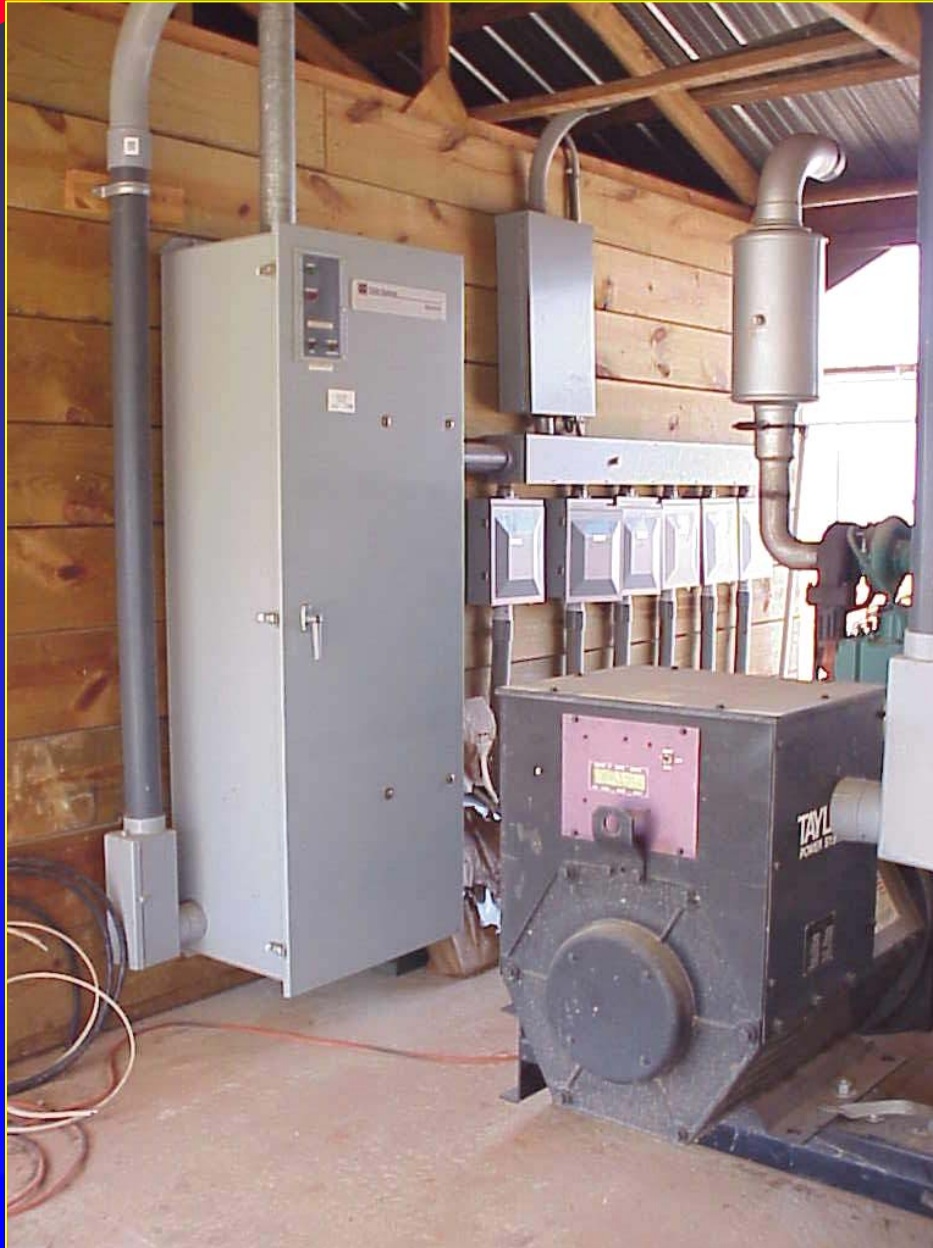
- ← Additional New Construction Cost Of Solid Sidewalls On A 40' X 500' House Is ~ \$2,000 More Per Side Than Curtain Sided
- ← Retrofit Existing Houses Is More Expensive
- ← Cost Of Replacing 430 Feet Of 3' Curtain & Flaps = \$1,500 (\$1,000 In Materials And \$500 In Labor). 5' Curtain Costs \$2,000
- ← Solid Sidewall Eliminates The Need For Bird Wire, Curtain Drops, And Curtains
- ← Easier To Keep Rats Out Of Bldg. Cavities

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Additional Items To Consider

- ← Vapor Barrier - Next To Heat & Continuous**
- ← Condensation Problems**
- ← Grower's Management Skill**
- ← Generator/Fuel Supply/Maintenance**
- ← Electrical Service & Grounding**
- ← Transfer Switch**
- ← Wiring To The House & Breaker Panels**

Electrical Is The Life Line



← Generator

← Out Of Weather

← Out Of Sun

← Electrically Correct

← Maintenance Correct

← Need 1.5 -1.7 HP
Per kW

Thin Insulation Or No Insulation Causes Sweating



Blown Cellulose Ceiling

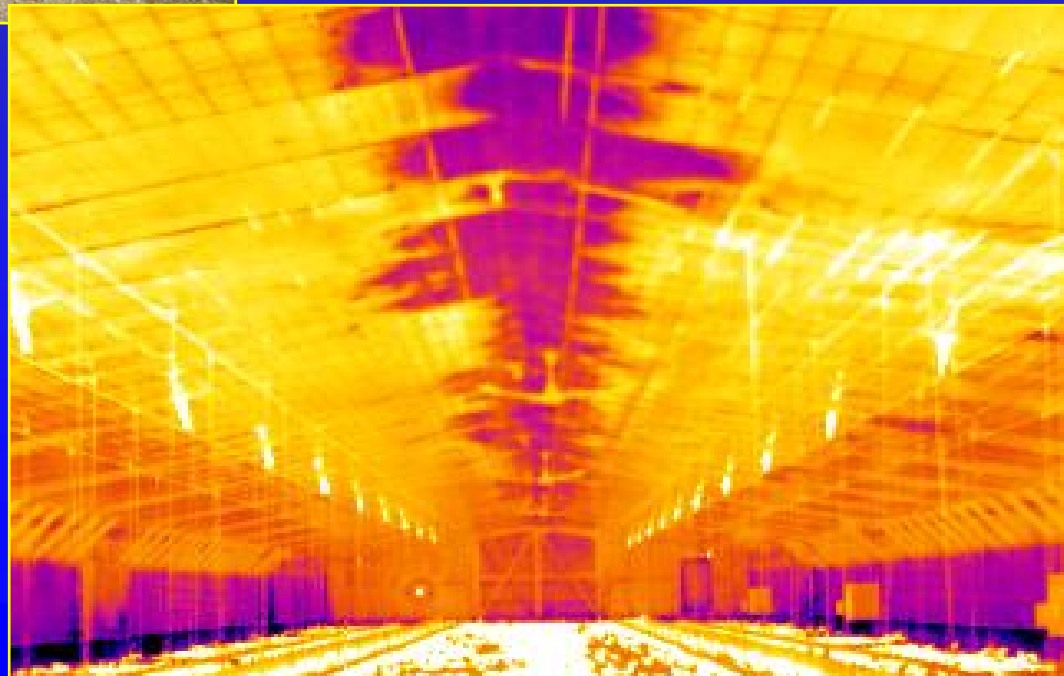


Blown Ceiling Insulation Shifts



**Install 1X4 “Dam”
Between Trusses To
Prevent Shifting, Or
4’ Batts Over Center**

**Infrared Picture
Of Cold Spots In
Blown Ceiling
After Shifting**



Insulate End Walls



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Sprayed Closed Cell Foam

- ← R-7/Inch, Dries Firm, Water & Fire Proof**
- ← Makes Solid Walls That Seal & Insulate**
- ← Spray Through Wire Onto Nailed Curtain**
- ← Fill Joints, Stop Leaks, Improve Tightness**
- ← Patch/Seal Ridgecap On Open Ceilings**
- ← Insulate Doghouse Ceiling & Eaves**
- ← Extend Productive Life Of Older Houses**
- ← Spray 1.5" On Sidewalls, Touch-up Cracks**
- ← Must Control Darkling Beetles**

Sprayed Closed Cell Foam



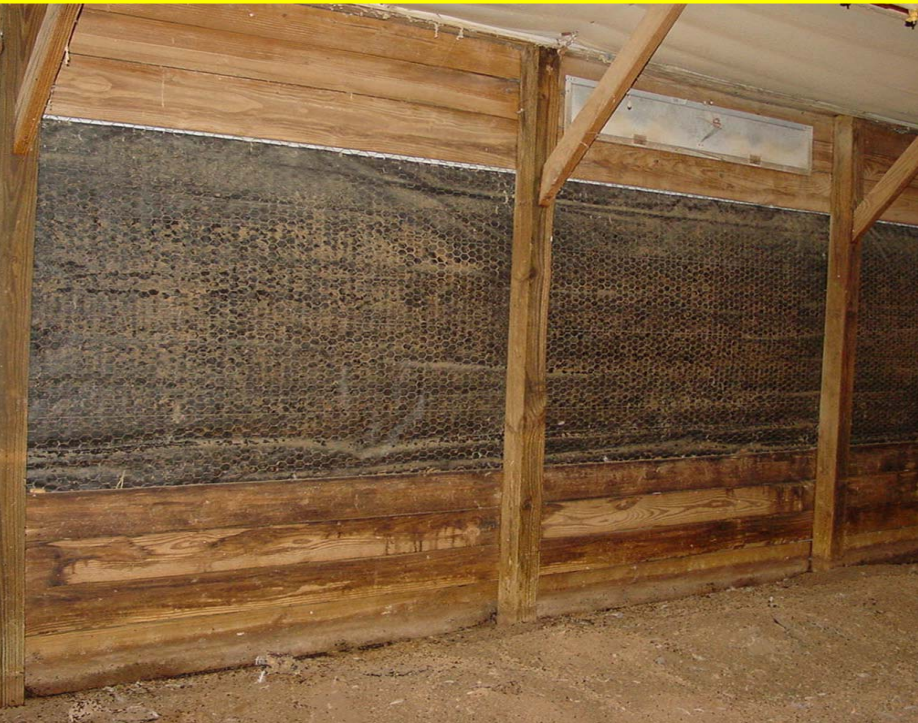


Ag Energy Efficiency Test

- ← ADECA Funded For FY'06
- ← 12 House Broiler Farm In Blount County
- ← 6 Houses – Closed Cell Foam Walls – R5-R8
- ← 6 Houses – No Treatment
- ← Application Performed in Mid-October '05
- ← For 7 Flocks (1 Year) We Will Compare:
 - ← House Tightness & Ventilation Efficiency
 - ← Electric Consumption
 - ← Propane Consumption
 - ← Flock Performance



Closed Cell Foam Application



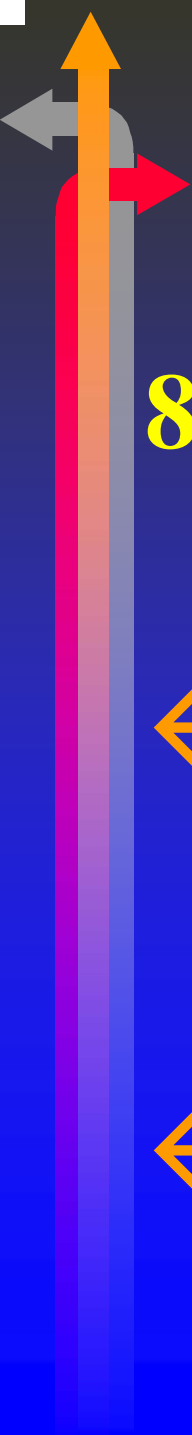
SP Before 0.08



SP After 0.22

IR Photo Of Sprayed Sidewalls





Heat Loss Example Scenarios

85°F Inside, 15°F Outside (70°F Temperature Difference)

← Scenario #1 - Conventional, 40' X 500' Dropped Ceiling, 5' Curtain, Minimum Insulation (R-11 Ceiling Only)

← Scenario #2 - Solid North Wall Plus Re-Blow Ceiling To R-19



Heat Loss Example Scenarios

← Scenario # 3- Solid North Wall
Plus Insulation (Insulate North Sidewall
& Endwalls To R-11, Insulate Ceiling To R-
19, Reduce South Curtain Opening To 3 ft.,
Insulate Rest Of South Sidewall To R-11)

← Scenario #4 - Both Solid Walls
Plus Full Insulation



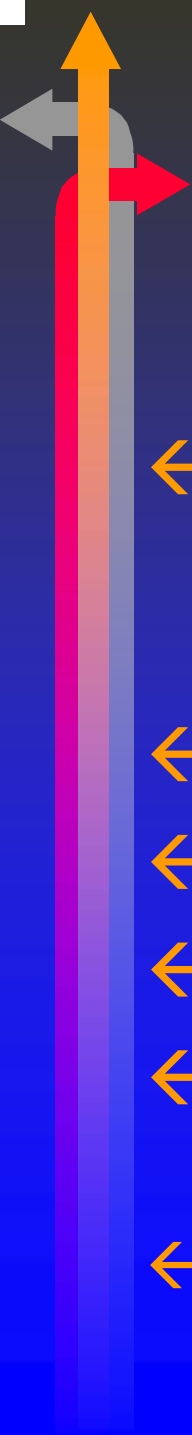
Surface Heat Loss Calculations

← Surface Area X Temperature Difference
R Value (Outside - Inside Temp.)

← Equals BTUs/Hr

← 91,600 BTUs Per Gallon Of Propane

← (Round Off To 90,000 BTU/Gal)



Ventilation Heat Loss Calculations

- ← Sq. Footage X Temp. Diff. X Vent. CFM Coeff.
Equals BTUs/Hr
- ← Vent CFM Coeff. = .30 for Conventional
- ← Vent CFM Coeff. = .26 for 1 Solid Wall
- ← Vent CFM Coeff. = .24 for 1 Solid Wall + Insulat.
- ← Vent CFM Coeff. = .20 for 2 Solid Walls + Insulat.
- ← **Vent CFM Coefficients: Michael Czarick, Univ. of GA



Scenario #1 (Vent Coeff. = .30) (Conventional House)

← Ceiling Loss = 133,636 Btu/hr (15%)

← Sidewall Loss = 105,000 Btu/hr (11%)

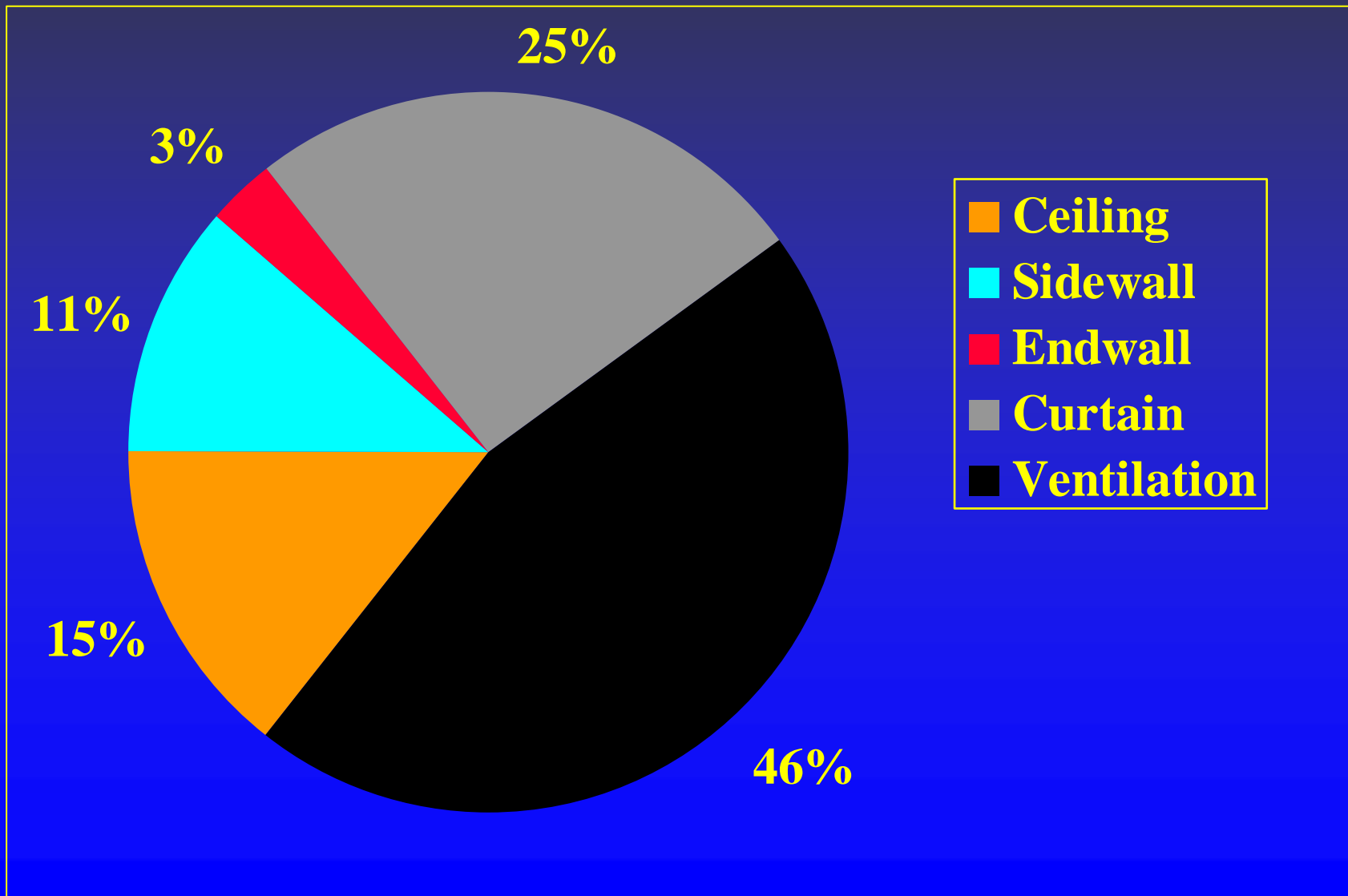
← Endwall Loss = 28,000 Btu/hr (3%)

← Curtain Loss = 233,333 Btu/hr (25%)

← Ventilation Loss = 420,000 Btu/hr (46%)

**Total Heat Loss = 919,969 BTU/Hr - Requires
10.22 Gal Propane/Hr To Maintain 85°F**

Heat Loss - Scenario #1





Scenario #2 (Vent Coeff. = .26) (Solid North Wall + R-19 Ceiling)

← Ceiling Loss = 77,368 Btu/hr (10%)

← N Sidewall Loss = 140,000 Btu/hr (18%)

← S Sidewall Loss = 52,500 Btu/hr (7%)

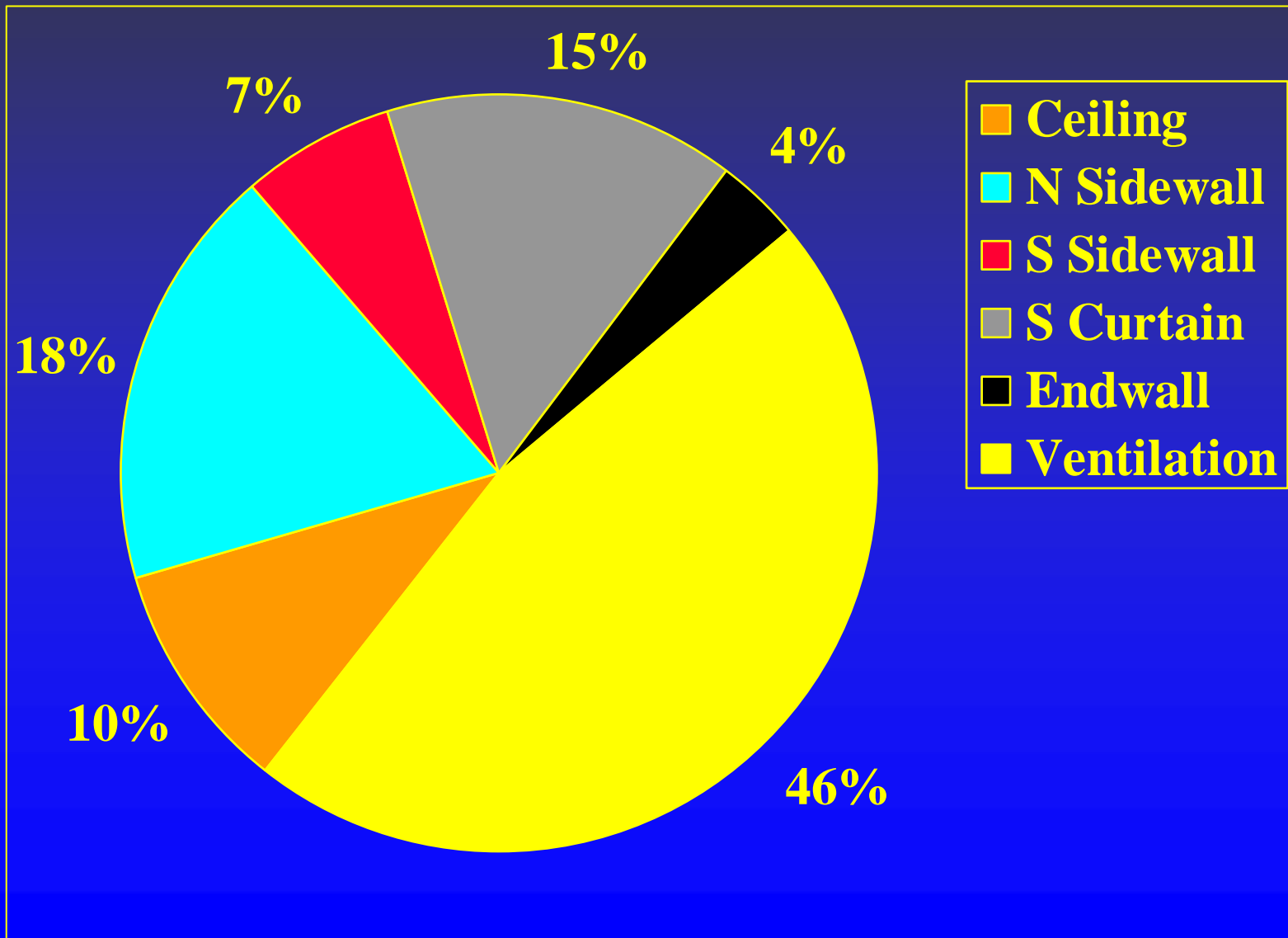
← South Curtain Loss = 116,666 Btu/hr (15%)

← Endwall Loss = 28,000 Btu/hr (4%)

← Ventilation Loss = 364,000 Btu/hr (46%)

**Total Heat Loss = 778,534 Btu/Hr - Requires
8.65 Gal Propane/Hr To Maintain 85°F**

Heat Loss - Scenario #2





Scenario #3 (Vent Coeff. = .24)

(One Solid Wall + Full Insulation)

← Ceiling Loss = 77,368 Btu/hr (14%)

← N Sidewall Loss = 25,454 Btu/hr (5%)

← S Sidewall Loss = 15,909 Btu/hr (3%)

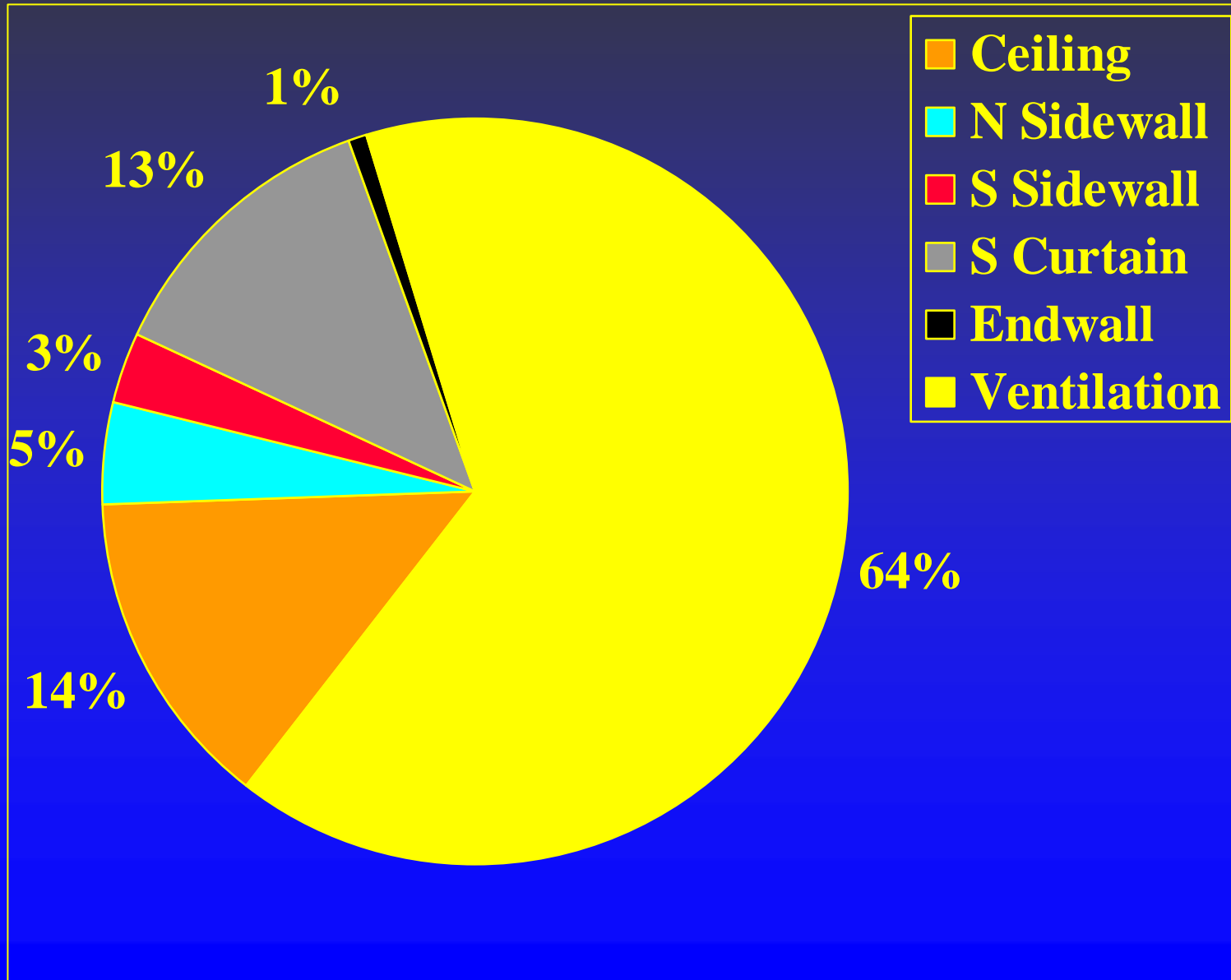
← South Curtain Loss = 70,000 Btu/hr (13%)

← Endwall loss = 5,090 Btu/hr (1%)

← Ventilation Loss = 336,000 Btu/hr (64%)

**Total Heat Loss = 529,821 Btu/Hr - Requires
5.89 Gal Propane/Hr To Maintain 85°F**

Heat Loss - Scenario #3





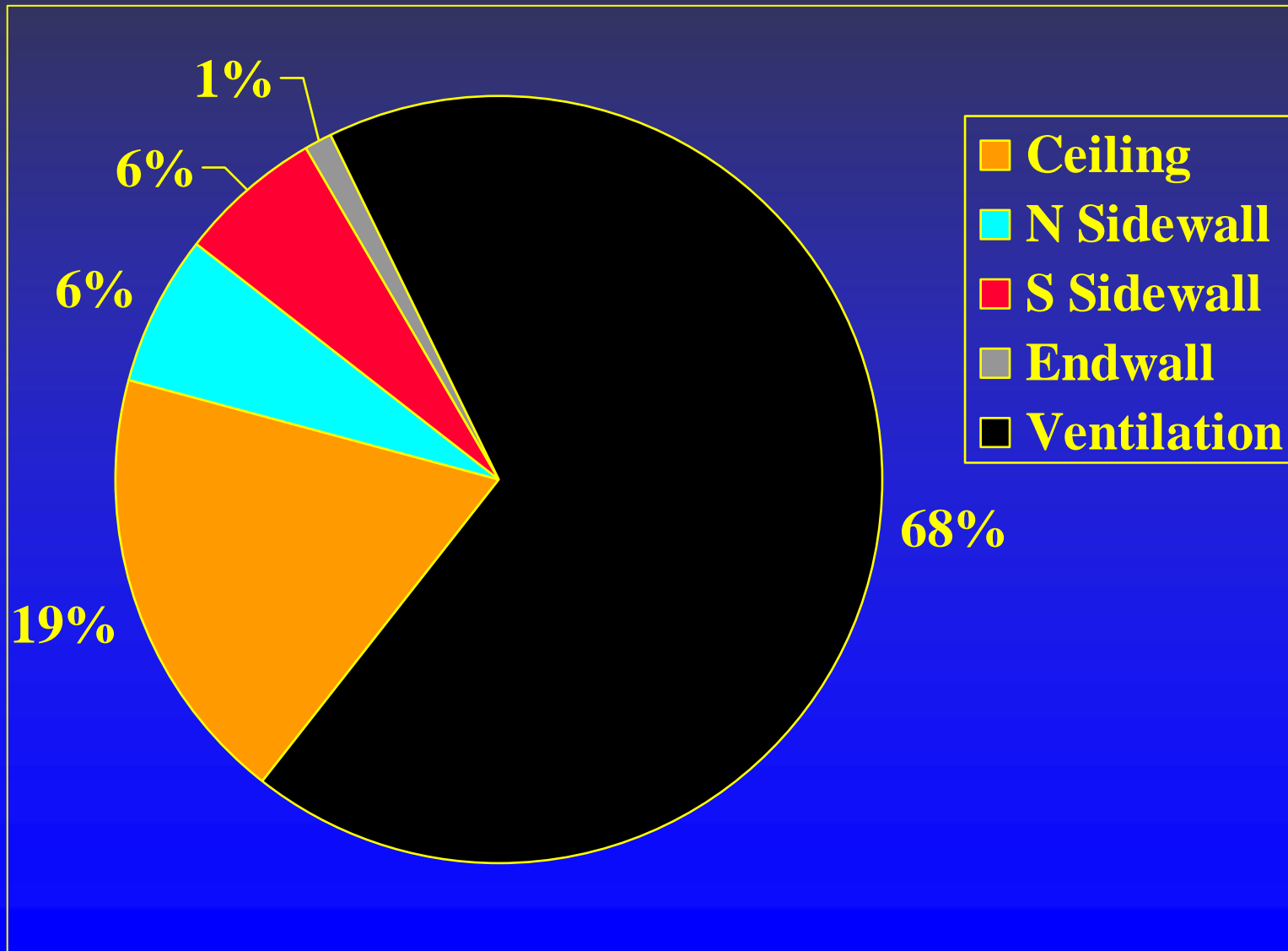
Scenario #4 (Vent Coeff. =.20)

(2 Solid Walls + Full Insulation)

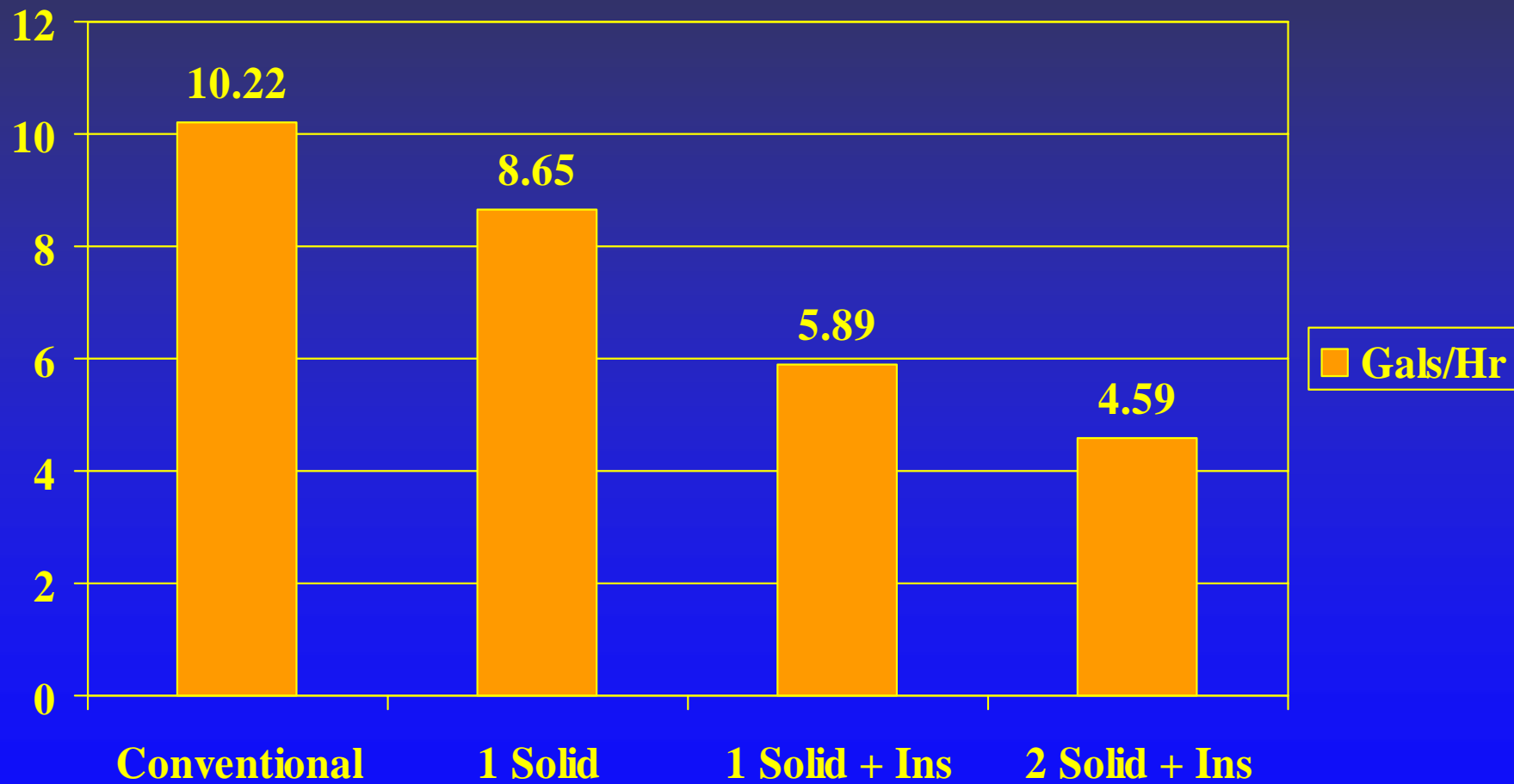
- ← Ceiling Loss = 77,368 Btu/hr (19%)**
- ← Sidewall (N) Loss = 25,454 Btu/hr (6%)**
- ← Sidewall (S) Loss = 25,454 Btu/hr (6%)**
- ← Endwall Loss = 5,090 Btu/hr (1%)**
- ← Ventilation Loss = 280,000 Btu/hr (68%)**

**Total Heat Loss = 413,366 Btu/Hr - Requires
4.59 Gal Propane/Hr To Maintain 85°F**

Heat Loss - Scenario #4

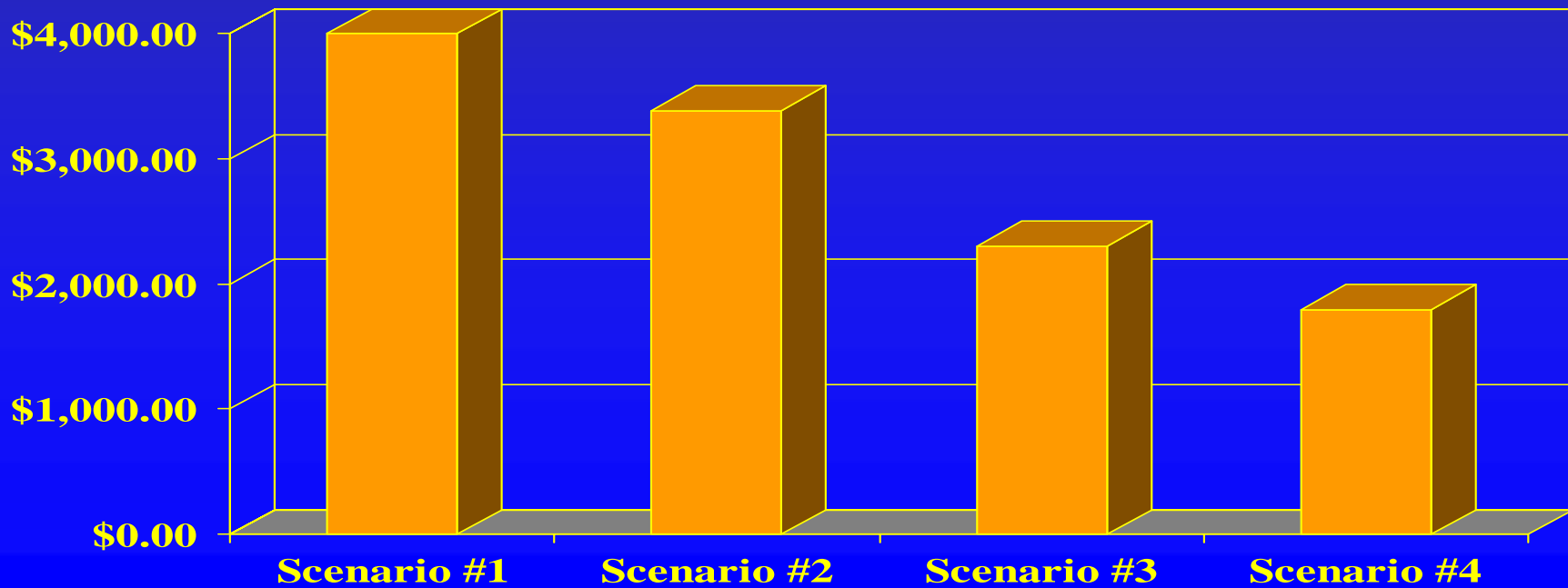


Hourly Fuel Use Summary



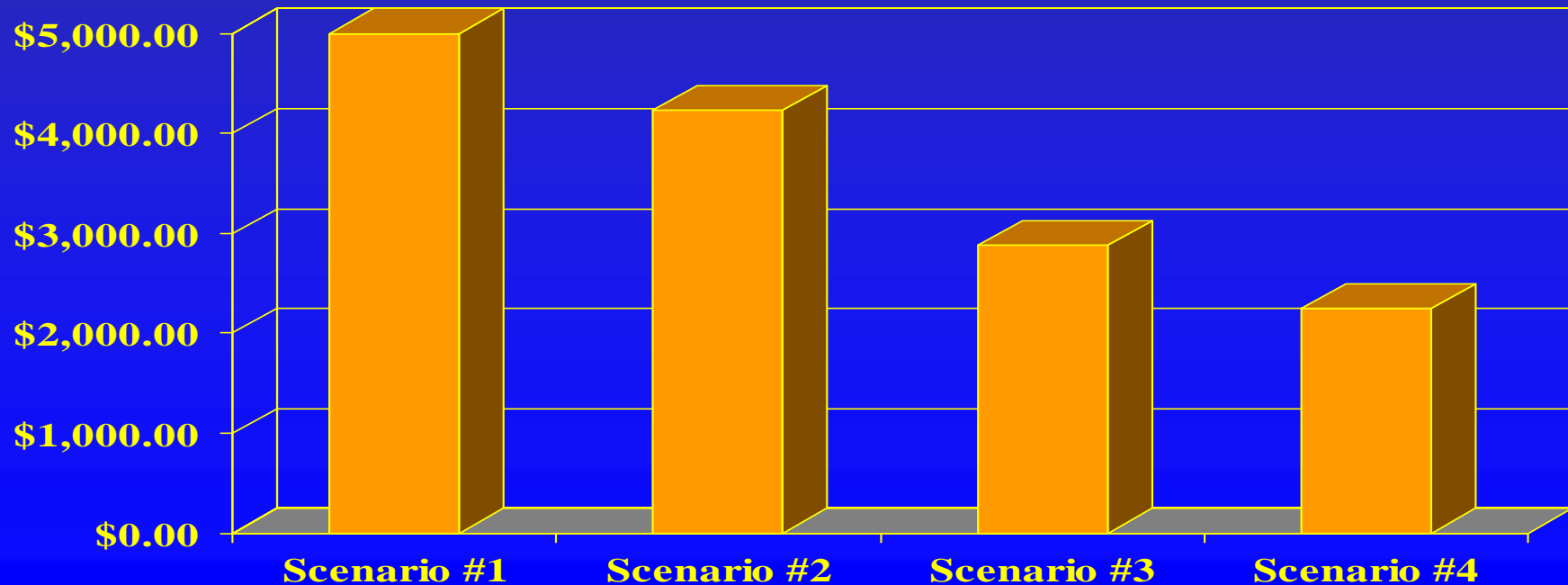
Annual Gas Savings @ \$0.80/Gal

Scenario	Gas Use	Gas Cost	Savings
1	<u>5,000</u> gal	\$4,000	---
2	4,232 gal	\$3,386	\$ 614
3	2,880 gal	\$2,304	\$1,696
4	2,247 gal	\$1,798	\$2,202



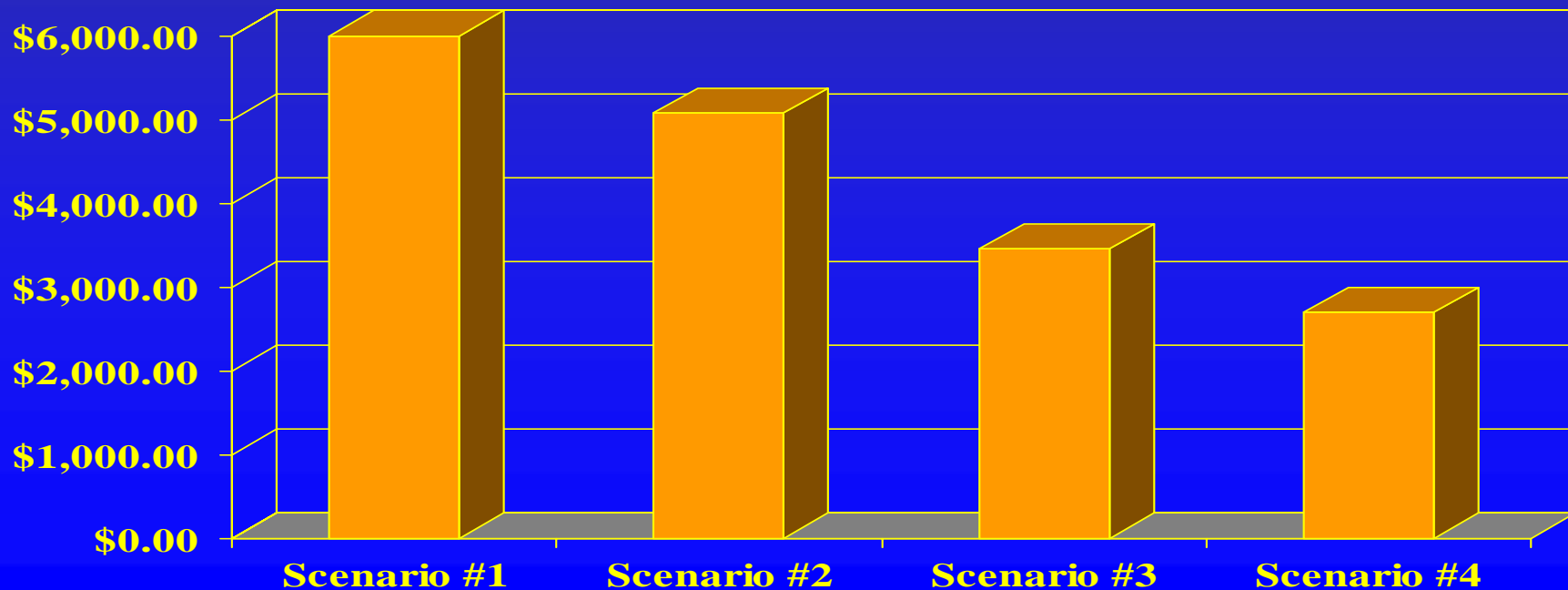
Annual Gas Savings @ \$1.00/Gal

<u>Scenario</u>	<u>Gas Use</u>	<u>Gas Cost</u>	<u>Savings</u>
1	<u>5,000</u> gal	\$5,000	---
2	4,232 gal	\$4,232	\$ 768
3	2,880 gal	\$2,880	\$2,120
4	2,247 gal	\$2,247	\$2,753



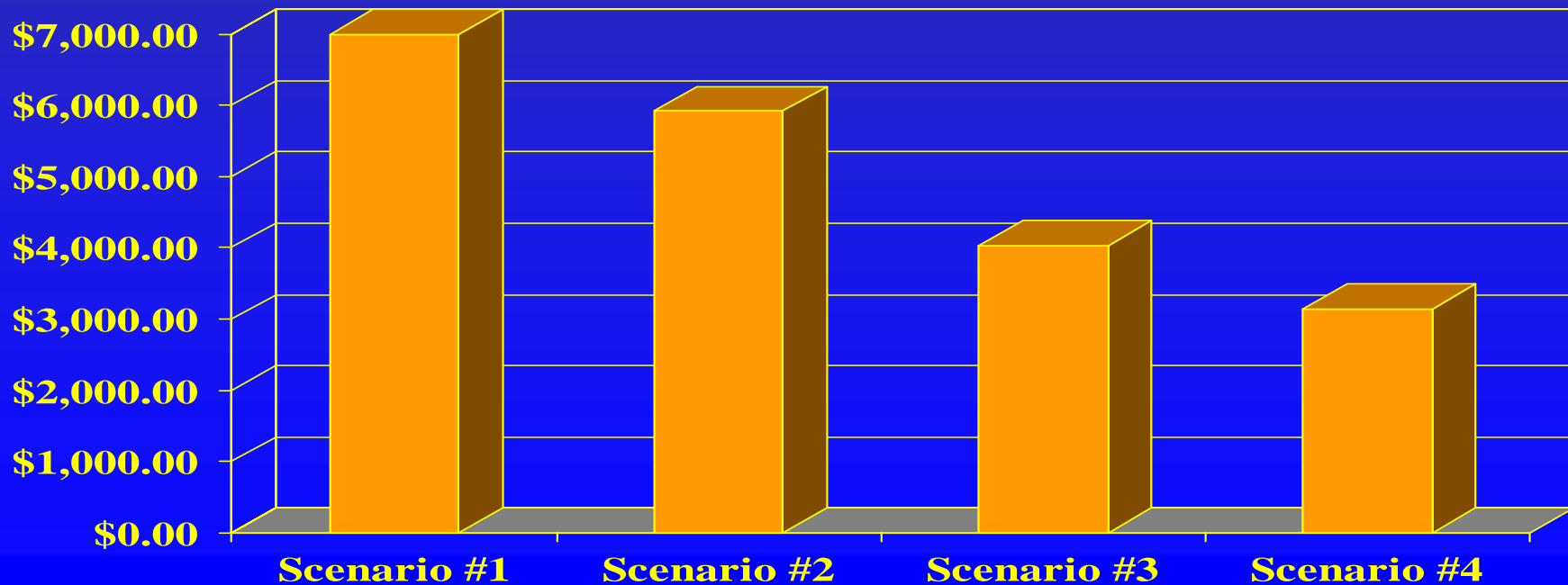
Annual Gas Savings @ \$1.20/Gal

<u>Scenario</u>	<u>Gas Use</u>	<u>Gas Cost</u>	<u>Savings</u>
1	<u>5,000</u> gal	\$6,000	---
2	4,232 gal	\$5,078	\$ 922
3	2,880 gal	\$3,456	\$2,544
4	2,247 gal	\$2,696	\$3,304



Annual Gas Savings @ \$1.40/Gal

<u>Scenario</u>	<u>Gas Use</u>	<u>Gas Cost</u>	<u>Savings</u>
1	<u>5,000</u> gal	\$7,000	---
2	4,232 gal	\$5,925	\$1,075
3	2,880 gal	\$4,032	\$2,968
4	2,247 gal	\$3,146	\$3,854

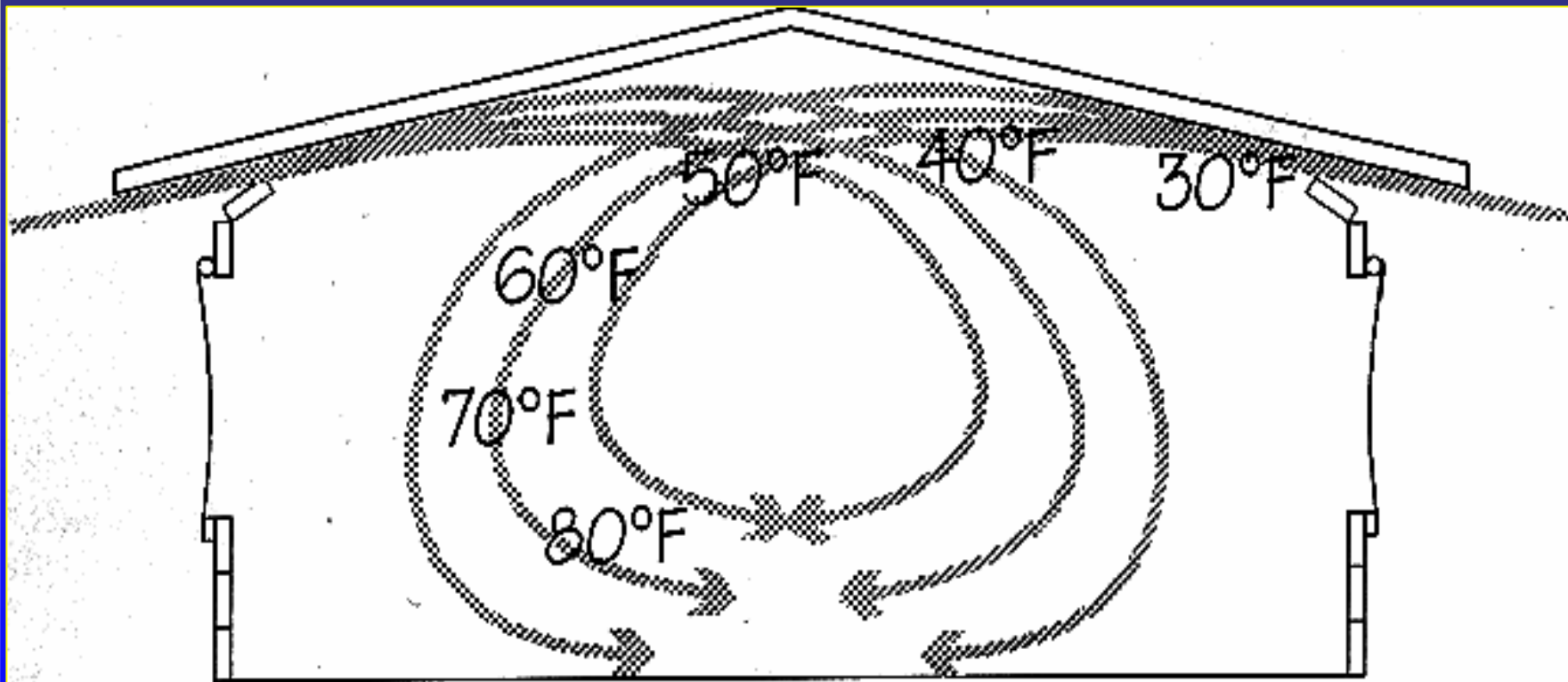


III. Ventilation Management



Inlet Management Controls:

Air Mixing, Temperature, Moisture Removal, And Fuel Usage



Negative pressure ventilation using adjustable inlets

Inlet Management Affects Fuel Usage

← SP Good

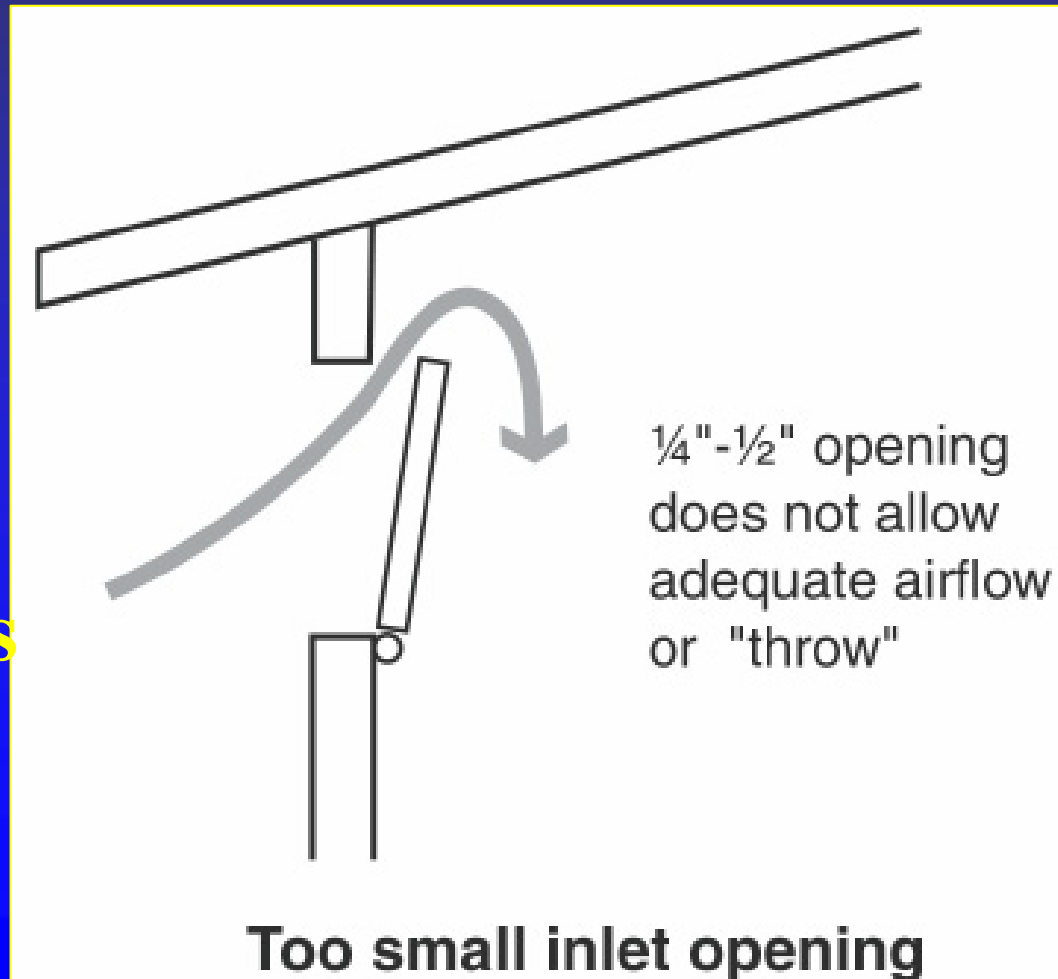
← Temp Good

← Air Mixing Poor

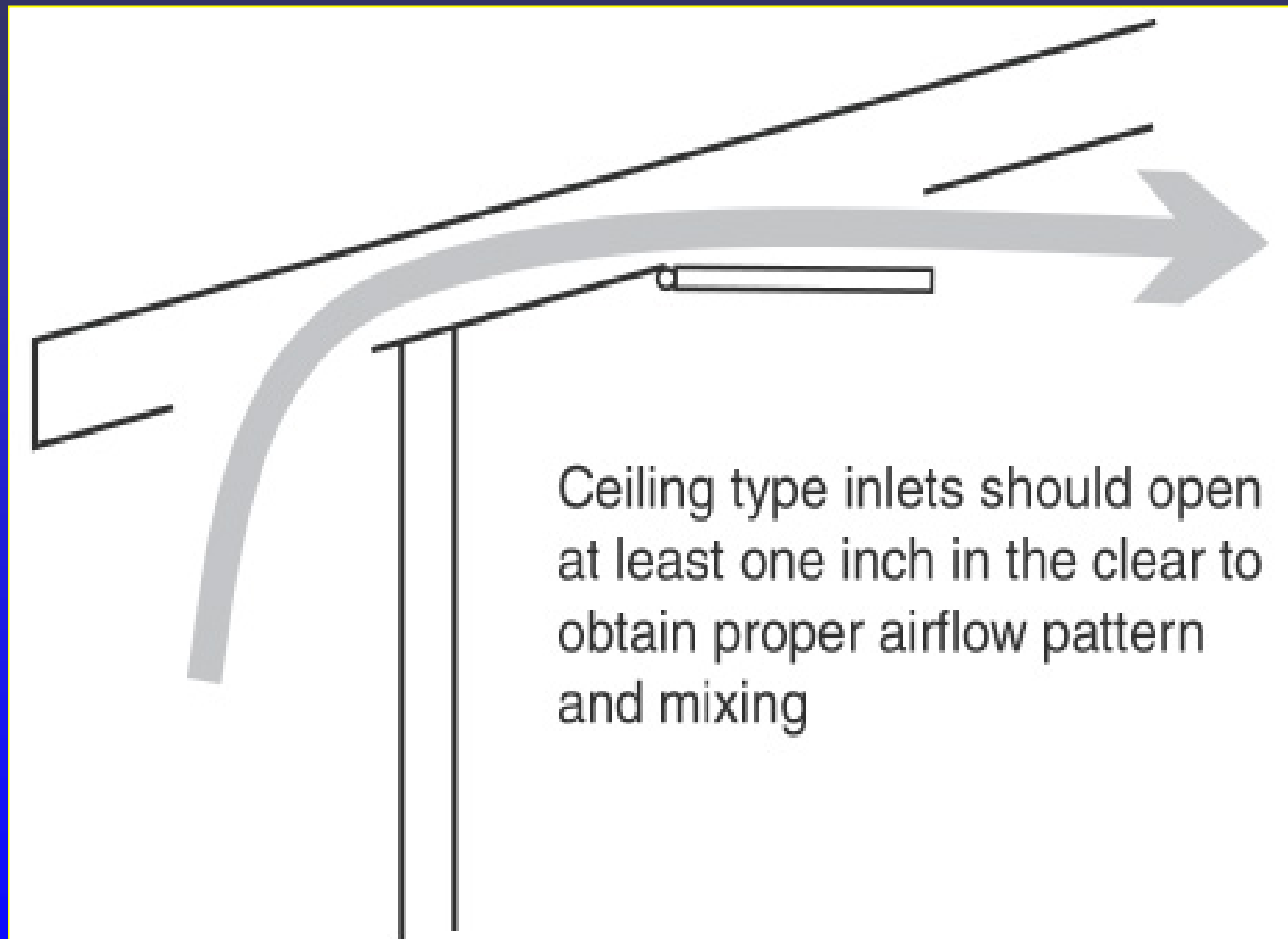
← Litter Quality Poor

**Optimum Opening
Is 1¼ To 1½ Inches**

**Steel Rod Better
Than Cable**



Ceiling Inlet Opening For Good Airflow



Ceiling type inlets should open at least one inch in the clear to obtain proper airflow pattern and mixing

Proper ceiling inlet opening



**Stirring Fans Help
Temperature
Uniformity And Reuse
The Heat**



IV. Propane Pricing



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Poultry Energy Use

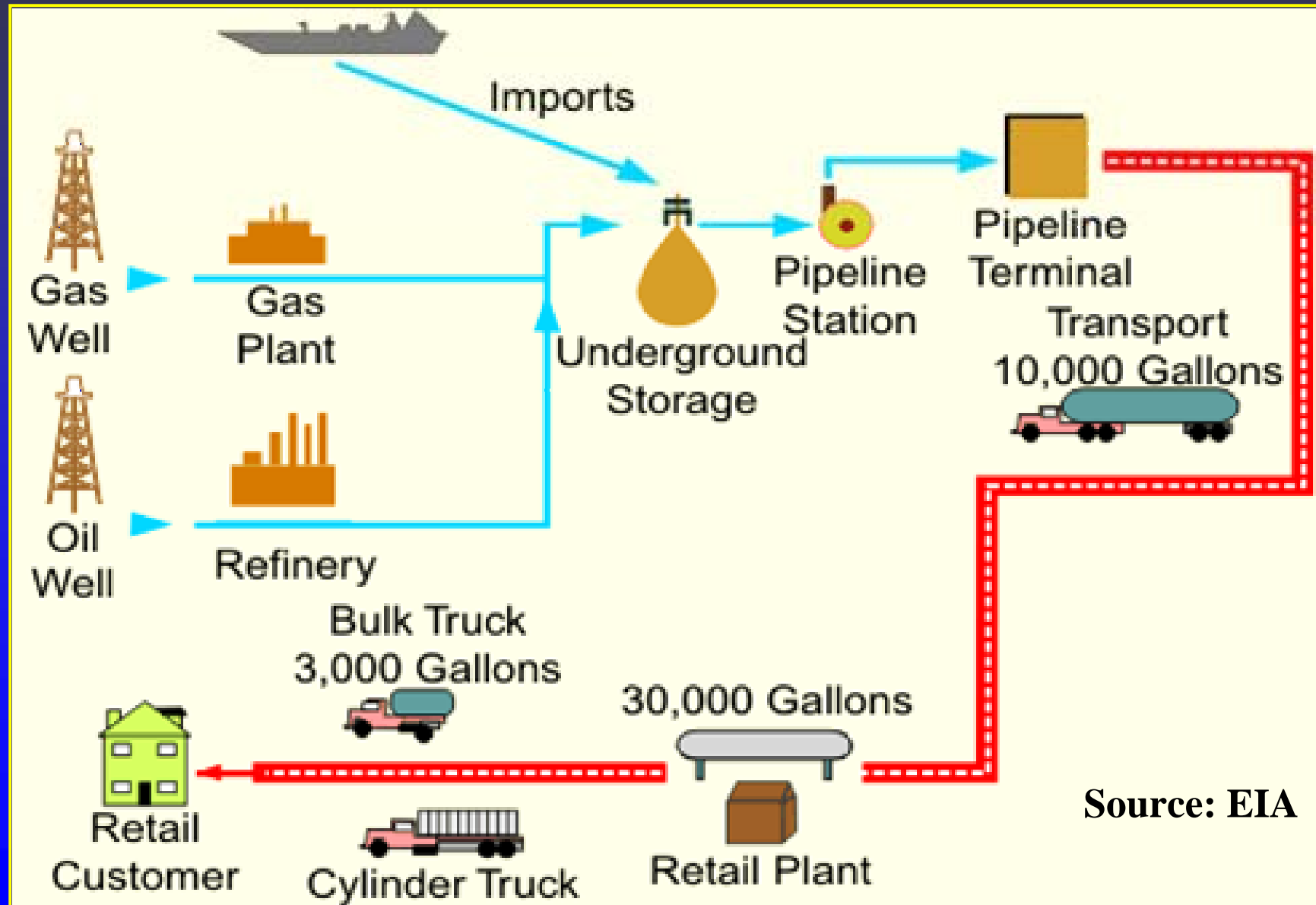
- ← Energy Is Greatest Cost To Growers
- ← Electricity - Requires 20,000-35,000 kwh Per Year Per House
- ← Electricity Rates - Highly Regulated & Relatively Stable
- ← Electricity Cost Ranges From \$1,500 to \$2,500 -- Average of ~ \$2,000/House/Yr.



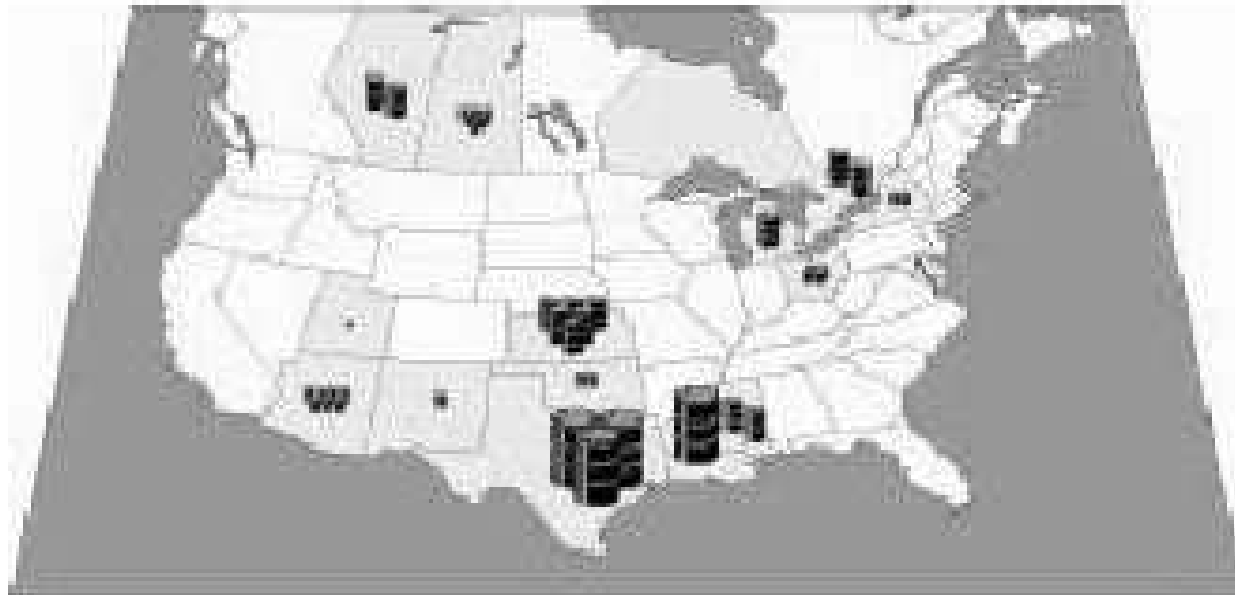
The Problem Is Propane

- ← Poultry Production Is Propane Intensive
- ← House Uses From 200-700 Mil. BTU/Yr.
- ← Middle East - Conflicts & Uncertainty-S
- ← Gulf Coast Storms Disrupt Prod. & Dist.-S
- ← China – 8-10% Annual Industrial Growth-D
- ← Hard Winter Up North Spurs Demand-D
- ← Propane Follows Crude Price – OPEC? S&D
- ← Crude \$60-\$70; Last Year \$40; \$25 2 Yrs Ago
- ← Propane Market Fluctuates Wildly – It's Holding Our Industry Hostage

U.S. Propane Distribution



Propane Salt Dome Storage Sites



• = 1 MMB = 1 million barrels = $1.59 \times 10^5 \text{ m}^3$

■ = 10 MMB

■ = 100 MMB

Figure 1. Light Hydrocarbons in Salt Caverns in the U.S. and Canada

Most U.S. Salt Dome Cavern Storage Sites Are Along The Gulf Coast.

The Area East Of Houston Is The Hub Of U.S. Pipeline Network



Propane Pricing Options

Goal Is Price Protection (Price Insurance) To Pay Less Per Gallon.

But Reducing Gallons Used Is The Real Key Long Term.

1. “Booking” Gas – Forward Pricing
2. Pre-Payment For Fixed Quantity/Year.
3. Bulk Tanks and Bulk Load Purchasing.



1. Propane Pricing Options

“Booking” Gas – Forward Pricing @ Fixed Price Or “Mt. Belvieu Plus” Price.

Book Either As An Individual Or As A Group. Group (Co-op) Approach Is Preferred. Current Poultry Growers Association N. AL Contract With United Propane Is \$1.19/Gallon, Up From \$0.91 Last Season (28 Cents, Or ~ 31%). Similar Contracts in S. AL.



2. Propane Pricing Options

Pre-Payment For Fixed Quantity/Year.

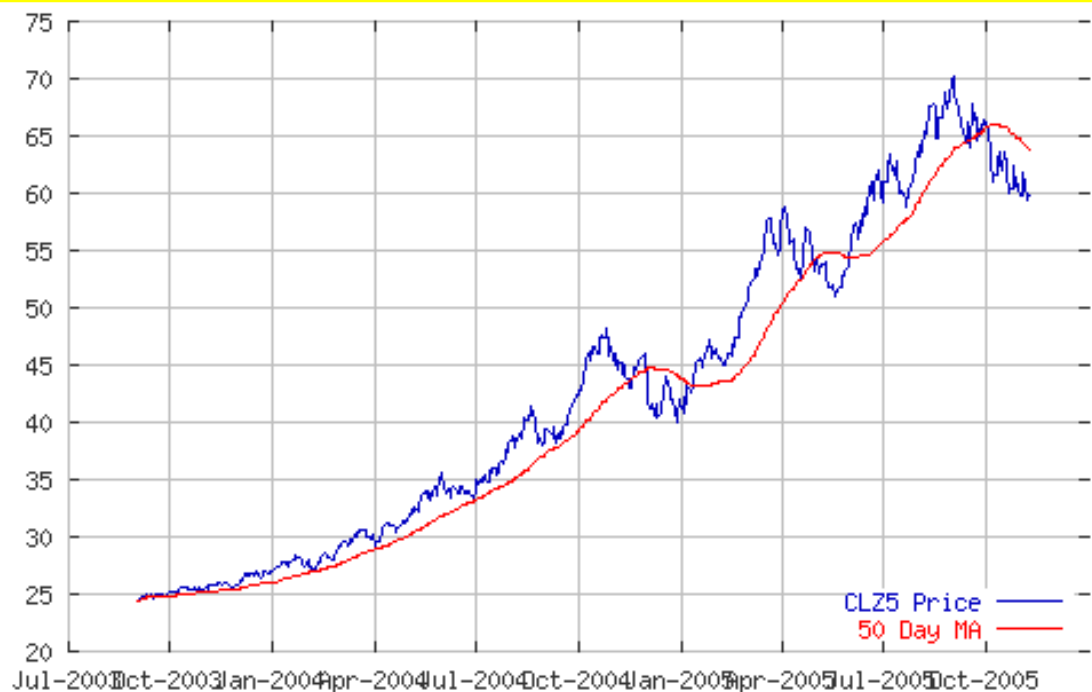
Short Term Loan From Bank With Interest.
Pay In Advance for Anticipated Annual Use.
Example: 7% For 6 Months Costs About
Four Cents, So Any Pre-Payment Price
Better Than 4 Cents Is Worthwhile. Best
Time Is Late Spring/Early Summer.

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3. Propane Pricing Options

Bulk Tanks and Bulk Load Purchasing.

Bulk Purchasing In Loads Of 9,000, 18,000, Or 30,000 Gallons Can Save 12-15 Cents Per Gallon. However, Initial Investment For Installing Tank Can Be \$1.00-\$1.25 Per Gallon Of Tank Capacity. In Some Areas, Permitting And Annual Inspections May Be Required. Do the Math.



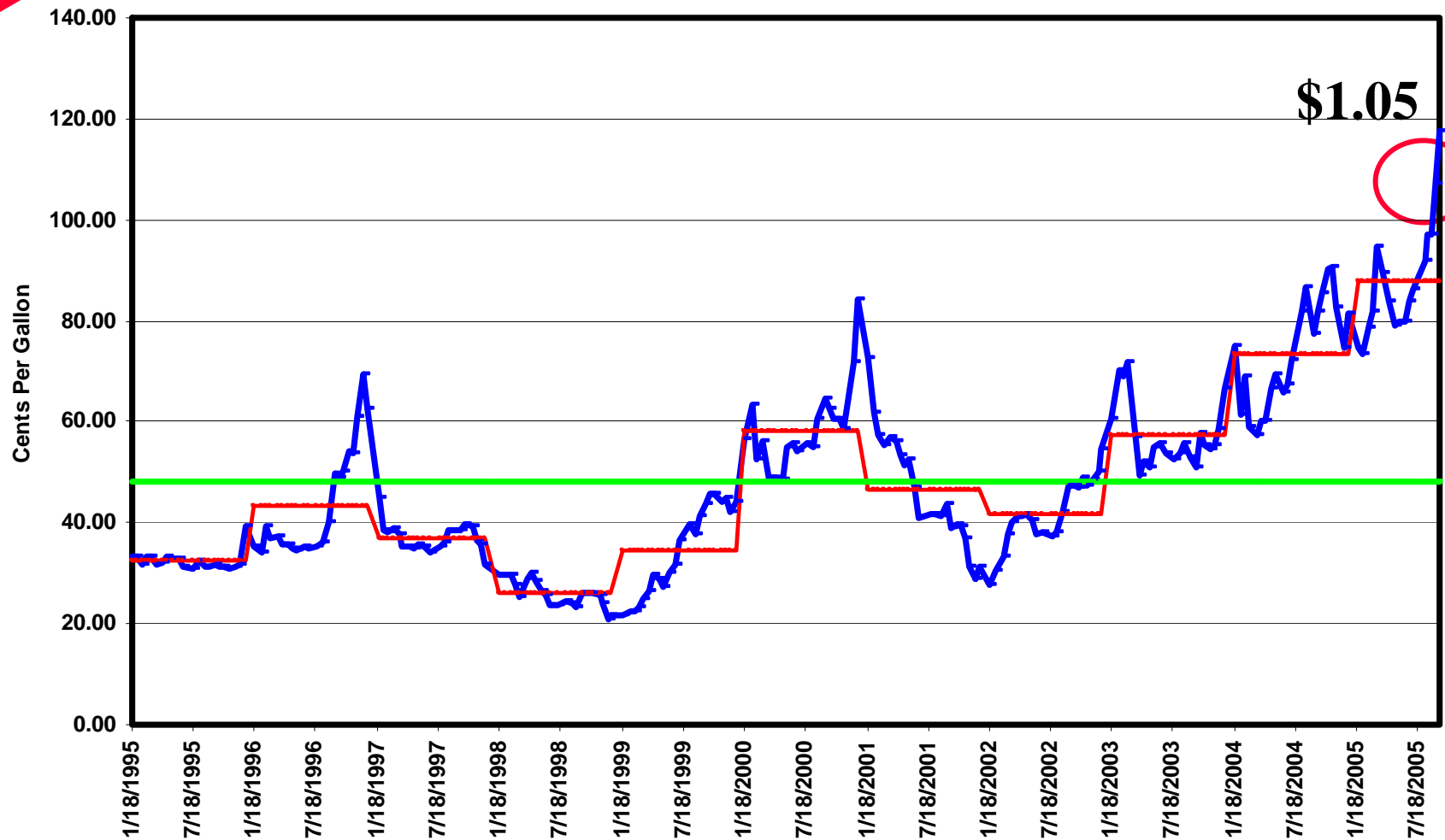
Dec Crude Oil

**NYMEX 2005
Futures Prices**

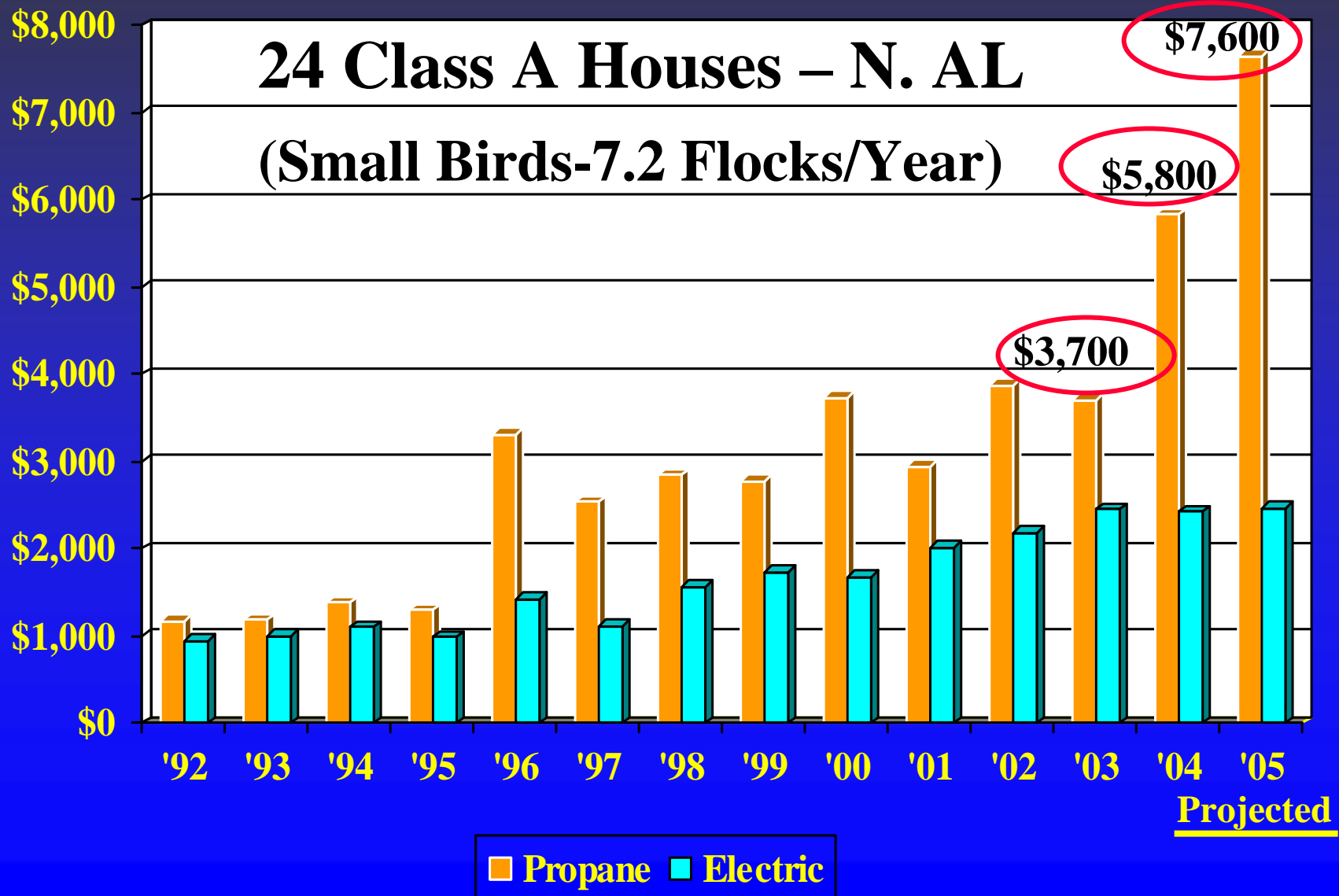


Dec Propane

Mont Belvieu Propane Spot Price



Per House Energy Costs



Gas Cost - 8 House S. AL Farm

(Big Birds-5 Flocks/Year)

←2002-03 30,000 gals @ \$0.55 = \$16,500

←2003-04 30,000 gals @ \$0.80 = \$24,000

←2004-05 30,000 gals @ \$1.02 = \$30,600

←2005-06 30,000 gals @ \$1.19 = \$35,700

Change = \$19,200 Less Net Farm Income



Net Effect Of Propane Price Increase Of 40 Cents/Gallon

← Costs ~ \$1,600/House/Year More In A Big Bird Program.

← Costs ~ \$2,400/House/Year More In A Small Bird Program.

← Average ~ \$2,000/House/Year
Reduction In Net Farm Income

(~\$25 Million In Alabama)

(~\$160 Million In SE US)



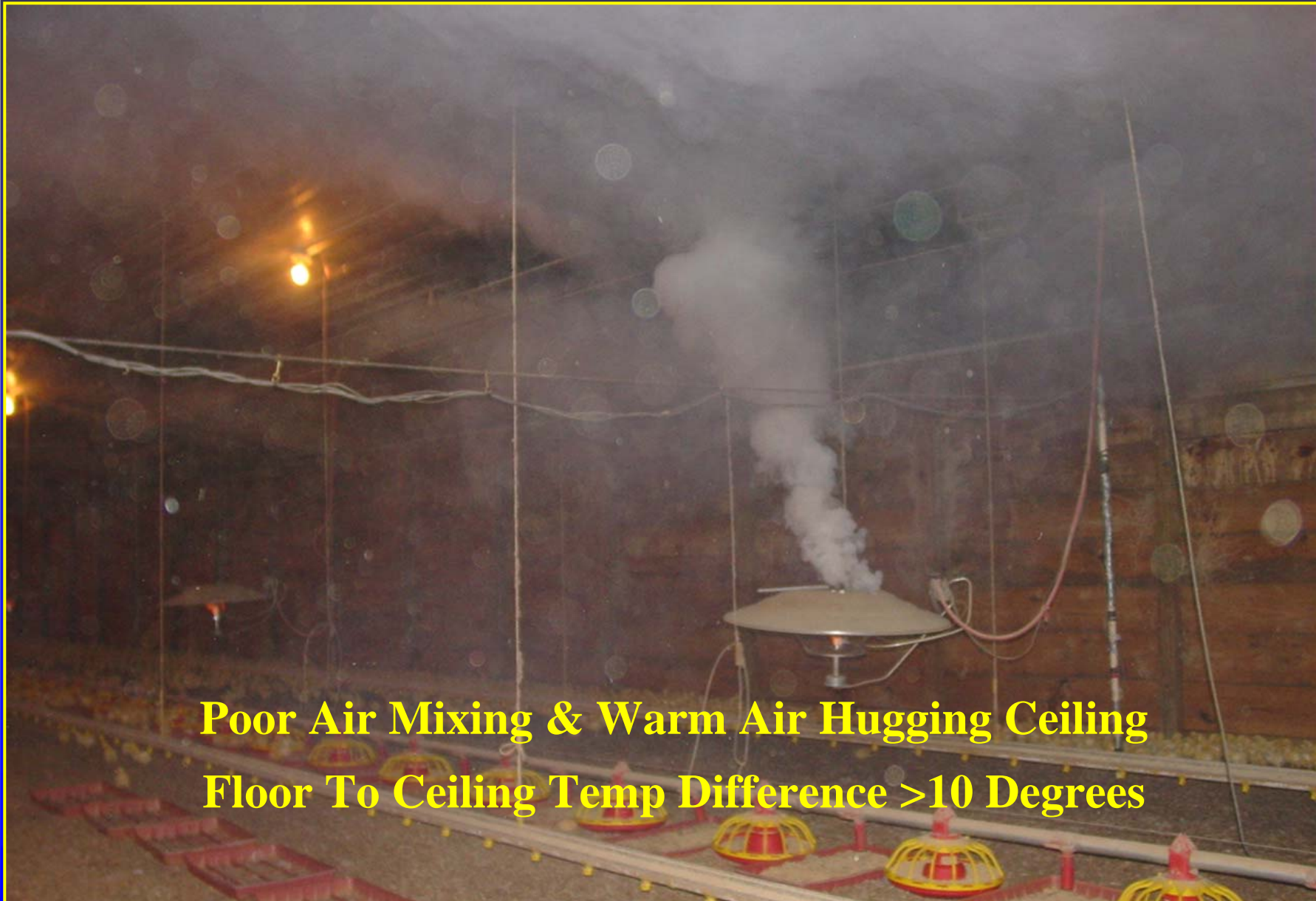
Do Something About Pricing Propane

- ← Seasonal Lows Usually Occur In Early Spring To Early Summer - Highs In Fall To Winter
- ← Pre-Pay, Contract, Or Buy Bulk Early In The Year
- ← Understand How To Save On Fuel Use Without Sacrificing Bird Performance
- ← Key Is To Reduce Both Price Paid & Quantity Used

V. Alternative Energy Systems



Conventional Brooder Heat Pattern



Poor Air Mixing & Warm Air Hugging Ceiling
Floor To Ceiling Temp Difference >10 Degrees



Challenges

- ← Adapt to Ever-Improving Bird Genetics
- ← Provide Adequate BTUs for Optimal Growth
- ← Minimize Temperature Differences
 - ← End to End, Side to Side, Floor to Ceiling
- ← Reduce Reliance on Petroleum (Propane/NG)
- ← Reduce Total Farm Energy Costs
- ← Improve Bird Performance
- ← Improve Profit & Ability To Plan Financially
- ← Reduce Environmental Load From Litter



We Need A Universal Furnace

- ← External Combustion - No CO₂ Or H₂O Put Into House (Bird Rearing Environment)**
- ← Capable Of Burning Any Fuel Or Mixture**
- ← Automated Fuel Flow & Feeding**
- ← Automated Ash Removal**
- ← Controller Operated**
- ← Affordable For Grower**
- ← Maintainable By Grower**
- ← Acceptable To Integrator**



We Need Improved Air Delivery

← Deliver Uniform, Optimal Temperature Throughout House

← Minimize Hot/Cool Spots

← More Efficient Delivery Of Available BTUs

← Might Deliver Heat With Tubular Ducts, Or Air Plenum With Fans, Or Other System

← Better Air Delivery → Better Environment → Better Performance → Better Income



Alternative Energy Costs/Mil BTU

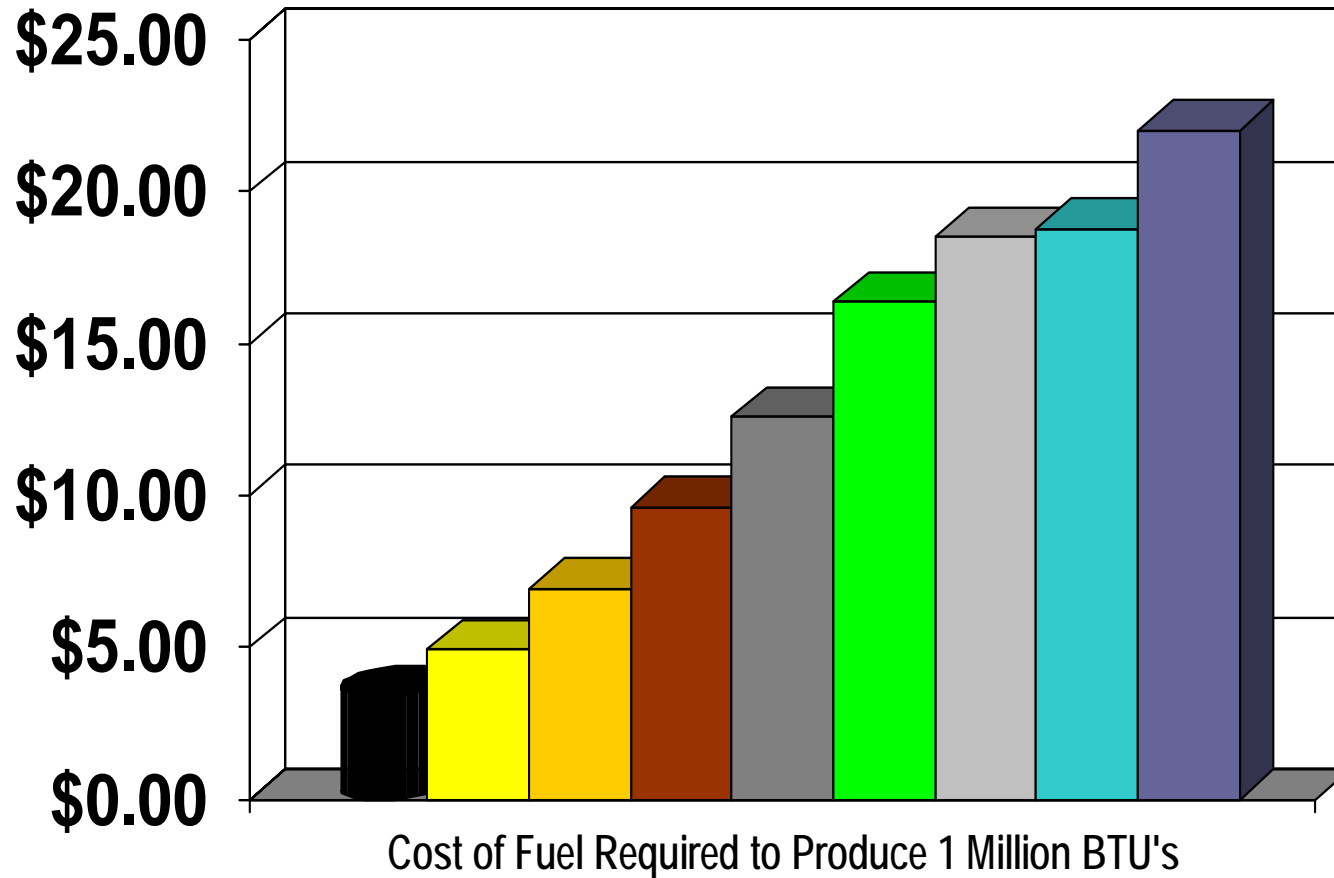
Type of Fuel	BTUs/ Unit	Units/ 1M BTU	\$/ Unit	% Effic.	Total Cost
Coal (lb)	10,000	100	0.03	88	3.41
Waste Oil (gl)	145,000	6.9	0.60	84	4.93
Corn (bu)	475,000	2.1	2.90	88	6.92
Hardwood (cd)	22Mil	.045	150.00	70	9.64
Wood Pellets (lb)	8,000	125	0.0875	87	12.57
Propane (gl)	91,690	10.91	1.20	80	16.36
Fuel Oil (gl)	145,000	6.9	2.25	84	18.48
Nat Gas (ft ³)	100,000	10	1.50	80	18.75
Electricity (kwh)	3,143	293	0.075	100	21.98

Total Cost Is Fuel Cost Per Million BTUs Produced

Other Fuels We're Testing:

Litter, Hay, Shredded Tires, Wood, Pallets, & Nursery Waste.

Relative Fuel Cost



Universal Furnace – Sample Components



Alternative Energy Furnaces

Many
Different
Recipes



Coal &
Ground
Tires



Corn



Litter & Coal

Furnace Feeding & Emissions



**Very Low Emissions
Low Opacity
(Tires, Coal &
Litter Mix)**



**Flow &
Augering
Issues**

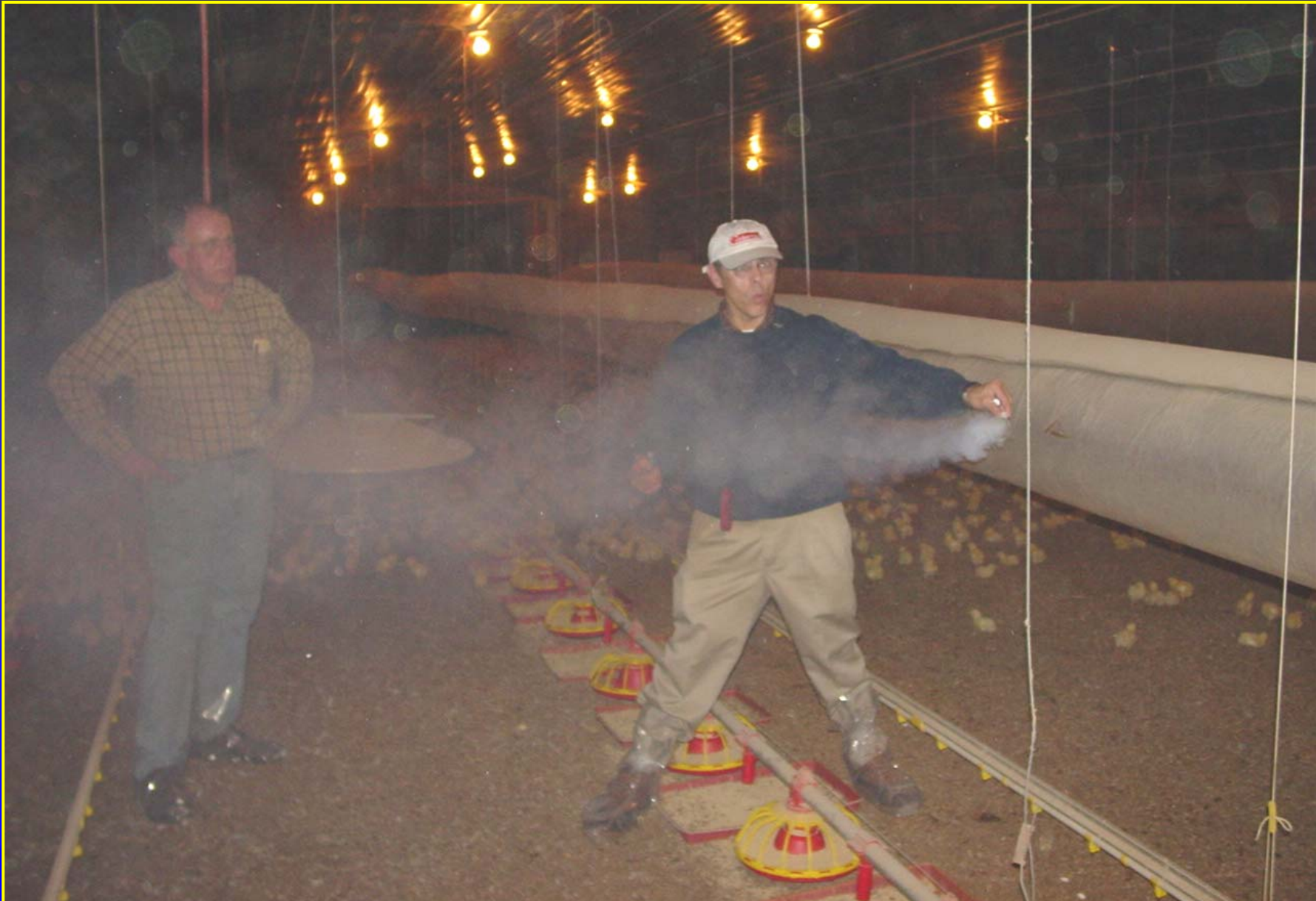
Oil Furnace, Tank, & Ducts



In-House Collapsible Nylon Duct



Hot Air Directed Down & Out





External Furnace Air Pattern

Smoke Pattern Shows Excellent Air Mixing
Floor To Ceiling Temp Difference <2 Degrees



Better Performance & Profit

<u>Item</u>	<u>Farm#1</u>	<u>Farm#2</u>
No. Flocks	6	4
Livability	+.38%	+.72%
FC	+.017	+.018
More Pounds	29,387	10,500
Poundage Value	\$1,469	\$525
Fuel Savings	\$1,751	\$495
Total	\$3,220	\$1,020

***Farm#1 – 6 Flocks Of 5.1# Birds Over 12 Months**

Farm#2 – 4 Flocks Of 3.8# Birds over 6.5 Months

Prices: .50 Waste Oil, .91 Propane, .05 Grower Pay

Additional Observations

Observations In All Test Houses:

- ← Lower Relative Humidity (15-20%)
- ← Litter Drier/Little Caking
- ← Much Less Cake Removed
- ← Much Less NH_3 (5-6 ppm)
- ← Shorter Vent Run Times
- ← Improved Air Circulation
- ← Improved Settlements
- ← Birds Appear More Comfortable & Content



A decorative graphic on the left side of the slide. It features a vertical orange arrow pointing upwards, a grey arrow pointing to the left, and a red arrow pointing to the right, all originating from a common point at the top left.

Potential Impacts/Benefits

- ← Reduction In Grower Heating Costs.
- ← Fewer Cleanouts-Less Annual Litter Volume.
- ← Litter Has Higher Nutrient Concentration.
- ← Alternative Use For Waste Products.
- ← Decreased Reliance on Propane.
- ← Increased Flock Performance.
- ← Increased Performance Life Of Older Houses.

A decorative graphic on the left side of the slide. It features a vertical orange arrow pointing upwards, a grey arrow pointing to the left, and a red arrow pointing to the right, all originating from a common point at the top left.

Potential Problems

- ← **Steep Grower Learning Curve for Several Flocks. This Is A New Approach to Heating & Ventilating.**
- ← **Local Availability of #5 Waste Oil Or Other Waste Products/Potential Fuels (S/D)?**
- ← **EPA, State, & Local Regulations Are Rapidly Changing Or Emerging.**

**Goal: A More Comfortable,
Uniform Bird Environment → \$\$**



Questions?



For More Information Visit
www.poultryhouse.com